OUR ASTRONOMICAL COLUMN.

THE SPECTROSCOPIC BINARY CAPELLA.—The *Lick Observatory Bulletin* No. 6 contains the final values adopted for the orbit of the spectroscopic binary system of Capella. The reductions are from thirty-one observations of the radial velocity of the solar-type component, made with the Mills spectrograph between 1896 September 1 and 1900 September 27. On most of the plates the spectra of the two components are distinguishable, that of the principal star being of the solar type, whereas that of the secondary component is intermediate between the solar and Sirian types. The ranges in velocity are as follow :—

Principal star +4·2 to +55·7 kilometres per second.
Secondary ,, −3 ,, +63 ,, ,,

Therefore the ratio of the two masses will be as 1·26 : 1.

The solar-type component is estimated to be about half a magnitude brighter photographically than the blue component, while in the visual region of the spectrum the solar component is probably a whole magnitude the brighter of the two.

In consequence of observations with the 36-inch refractor under good conditions failing to show the duplicity of star, it is probable that the distance between the components is not greater than 0″·06 .

The following are the final adopted elements, with their several probable errors :—

ω = 117°·3 ± 18°·3.
μ = 0·060403 ± 0·000014 radians.
= 3°·46082 ± 0°·00081.
T = −17·4 ± 5·3 days, the actual date being 1899 September 1·5.
e = 0·0164 ± 0·0055.
K = 25·76 ± 0·12.
U = 104·022 days ± 0·024 days.
$a \sin i$ = 36,847,900 kilometres.
V = + 30·17 ± 0·104 kilometres per second.

NEW SOUTHERN ALGOL-VARIABLE.—Mr. A. W. Roberts announces that observations made at Lovedale confirm the variability of the star,

R.A. = 10h. 16m. 44s.
Decl. = −41° 43′·8
} 1875.

The observations suggest the following elements :—

Period = 1d. 20h. 30m. 2s.
Epoch of Min. = 1900, Jan. 1d. 15h. 10m. (G.M.T.)
Limits = 10·0-10·9 magnitude.

The actual light changes are completed in 3h. 20m., and there appears to be no stationary period at minimum. The ascending and descending phases are equal, each occupying 1h. 40m. (*Astronomical Journal*, vol. xxii. No. 508.)

SPECTRUM OF NOVA PERSEI.—In the *Astronomische Nachrichten*, Bd. 156, No. 3741, Father Sidgreaves summarises as follows the results of his examination of recent photographs of the spectrum of the Nova Persei :—

All hydrogen lines are now relatively weak, excepting the doubtful line He.

λ5007 much stronger than Hβ or Hγ. Great width.
4958 prominent broad band.
4718 grown from a weak to strong band.
4713 strong line on edge of 4718.
4688 rather weak broad band.
4640 gradually weakened like hydrogen.
4364 very prominent band, stronger than Hγ, crossed by three bright lines.
3969 ?He. As strong as all other hydrogen lines together.
3869 stronger than 3969.

All these, with the exception of 4718, which shades off on red side, are broad with sharp edges. The structure of bands 3969 and 3869 very remarkable, being crossed by four strong lines of the same relative intensities and at the same intervals. This is also shown in the line 4364.

MICROMETRIC OBSERVATIONS OF NEPTUNE AND ITS SATELLITE.—In the *Astronomical Journal*, vol. xxii. No. 508, Prof. E. E. Barnard gives a series of micrometer measures of the satellite of Neptune extending over the period 1889 August 12—1901 February 5, made with the 40-inch refractor of the Yerkes Observatory. Many observations had been recorded previously, but it has been pointed out by Prof. Hall that only continuous measures of this object are of value. For the majority of the observations a power of 700 diameters was employed.

On three occasions it was possible to obtain good measures of the diameter of the planet, the reduced value being

d = 2″·436 (at mean distance = 30·0551).

A note is made of the fact that the planet, when seen under the best conditions, always appeared round and free from markings.

APPEARANCE OF THE PHOTOGRAPHIC IMAGE OF NOVA PERSEI.—MM. Flammarion and Antoniadi contribute a further article respecting the photographic image of Nova Persei to the October issue of the *Bulletin de la Société Astronomique*, which is specially interesting in that it is illustrated by drawings and reproductions from the photographs obtained, showing exactly the appearances presented. These have already been described; the suggested explanation by Dr. Max Wolf ascribing them to the objective not being corrected for some special radiation emitted by the Nova does not appear to have been definitely settled yet, but the great intensity of the ultra-violet lines in its spectrum, together with the fact of the existence of the newly observed line about λ 342, would seem to support this supposition.

RECENT PROGRESS IN WATERWAYS AND MARITIME WORKS.

THE fourteen papers presented to the section of Waterways and Maritime Works at the International Engineering Congress at Glasgow were for the most part descriptive of important recent works carried out in various parts of the world, as, for instance, the Dortmund and Ems Canal, the Assuan Reservoir Dam across the Nile, the improvement of the Lower Mississippi, the Chicago Drainage Canal, the breakwaters for sheltering the entrance to the River Nervion, the Zeebrugge Harbour Works, and recent improvements in the lighting and buoying of the Scottish and French coasts. Some papers, moreover, dealt with the gradual extension and recent progress of works commenced many years ago, as, for example, the improvement of the River Clyde and its estuary and the works of Glasgow Harbour, recent improvements in the navigable condition of the Sulina branch and outlet of the Danube, and the lighting of the Chinese coast.

Some of these works furnish, for the most part, a record of the steady development and extension of methods of execution, constituting in the end a very notable advance, of which, however, the stages have been numerous and gradual ; whilst other works present distinctly novel features, exhibiting a very definite progress in engineering science, and therefore of somewhat special interest, as will be briefly indicated.

The lift at Henrichenburg, on the Dortmund and Ems Canal, for raising barges of 950 tons from one reach of the canal to another, 46 feet higher, in a single operation, illustrates the novel principle of supporting the trough, carrying the barge, on several floats immersed in wells ; and the whole structure is so perfectly balanced that the introduction of a small quantity of water into the trough at the top causes it to descend, and the abstraction of some water from the trough when at the bottom makes it ascend, the actual transit being effected in two and a half minutes, though the whole operation of transferring a barge from one reach to the other occupies about twelve and a half minutes on the average. This system of simple flotation, in place of the older system of hydraulic lifts, consisting of two counterbalancing troughs, each supported centrally on a hydraulic piston which even for raising barges of from 300 to 400 tons has had to be given a diameter of 6½ feet, has enabled these canal lifts, with their important advantages over locks of saving largely both time and water, to be adopted for vessels of more than double the tonnage of those raised by the older canal lifts.

The large excavations required for the Chicago Drainage Canal led to the adoption of excavators and dredgers of unusual size, the bucket of some dipper dredgers having been given a capacity of six cubic yards ; whilst the removal of large masses of earthwork to the sides of the canal trench gave rise to the introduction of novel types of plant. These consisted of cableways suspended from high travelling towers on each side of the canal, along which skips conveyed the earthwork from the excavations to

the spoil banks on either side; conveyors forming a bridge stretching across the channel, with cantilever arms projecting over the spoil banks on each side, carrying a steel travelling belt which conveys the material to the depositing ground; cantilever conveyors running on rails along one bank of the trench, with one arm dipping down into the excavations and the other rising over the spoil bank, up which incline a trolley is drawn for disposing of the earthwork; inclined planes leading to a travelling bridge with an open roadway extending over the spoil bank, through which wagons drawn up the incline deposit their load; and, lastly, high-power revolving derricks and other machinery for the rapid and economical removal and deposit of the excavations.

The novelty of the reservoir dam in progress at Assuan across the Nile consists in the one hundred and eighty sluices by which it is pierced affording a waterway of 24,000 square feet, through which the whole flow of the Nile in flood-time will be discharged, amounting to a maximum of 475,000 cubic feet per second with a velocity of 20 feet per second. These openings will be closed for storing up water for summer irrigation, by counterbalanced sluice-gates working on free rollers, which can be readily raised or lowered against a considerable head of water.

The deepening of the navigable channel by about 3½ feet outside the Sulina mouth of the Danube since 1895 by dredging, giving an available depth of 24 feet, shows that it is possible under favourable conditions to cope with the deposits of a minor channel of a deltaic river by means of dredging, at any rate for a time; though it must be anticipated that eventually the accumulations of deposit in front of the mouth will necessitate an extension of the jetties, to enable an improved scour across the advancing delta to aid dredging in the maintenance of the depth of the outlet channel.

The injuries caused during two successive winters to the superstructure on the top of a rubble mound, forming the main breakwater in progress for sheltering the approach to the River Nervion leading to the port of Bilbao, exposed as this breakwater is to the full force of the waves rolling in from the Bay of Biscay during north-westerly gales, has led to the adoption of a novel method of depositing blocks of concrete of unusual size for the purpose of providing a secure foundation for the superstructure in this exposed site, where the breakwater extends into a depth of about 50 feet at low tide. The method comprises the construction of metal caissons to serve as a lining for the blocks, which are ballasted with concrete, floated out into position, and sunk in place by filling them with water, after which they are filled as rapidly as possible with large concrete blocks, and with concrete in mass in the interstices and on the top, so as to constitute a solid block, the largest blocks thus formed at the Bilbao Harbour Works having a weight of about 1500 tons. These blocks, laid in a row on the top of a rubble mound at a depth of about 16½ feet below the lowest low water, within the shelter of the original rubble mound with its capping of large concrete blocks, have proved a perfectly stable foundation for the superstructure which is being erected upon them. This system is being extended at Zeebrugge Harbour in the North Sea, at the entrance to the Bruges Ship Canal, where steel caissons have been constructed and lined with concrete, which are to be floated into position in calm weather one by one for the foundations of sea and harbour walls along each side of a quay, and an outer solid breakwater; and these blocks, when completed, will rest on the sea bottom, and weighing from 2500 tons up to 4400 tons, will emerge about 2½ feet out of water at low water of spring tides, so that a solid superstructure can be readily built upon them.

Remarkable progress has been achieved in recent years in the extension of appliances for the more efficient lighting of minor shoals, outlying reefs, and navigable channels. The ease of rotation obtained by floating the illuminating apparatus on an annular mercury bath, has enabled the system of group flashes, giving a distinctive character to each light, to be extended to beacons exhibiting a continuously burning light for three or four months, by rotating the light apparatus by an electric battery placed in a chamber in the beacon. The increased speed of rotation, moreover, rendered possible by the floating on a mercury bath, has enabled the number of panels of lenses to be reduced and their size increased, and consequently a brighter flash to be exhibited. Various improvements also have been effected in the lights themselves. Thus carbonised wicks have been devised which enable a light to continue burning without being attended to for a considerable period, with only a moderate deterioration in intensity; incandescent lamps have been adopted, fed by oil gas or petroleum vapour, which provide an excellent light; and acetylene is being experimented upon by the French Lighthouse Service, and the danger of explosion having been overcome by using very small tubes for supplying the burner, it appears likely to furnish a very bright, serviceable light. Special attention has been lately devoted to reducing the divergence of the light exhibited by lightships from the vertical, as with a considerable rolling of the vessel in a storm the light is liable to be obscured for a time. As it has been ascertained by observation that the waves in severe storms have a fairly definite period of oscillation in any particular locality, the special period of oscillation of the waves where a lightship is to be placed is ascertained; and the vessel is so designed, and its weights adjusted, that its period of roll may differ materially from the oscillation of the waves at its station; and the roll of the lightship is further checked by giving it a large draught and deep bilge keels. Moreover, the light and its accessories are supported on a sort of compound pendulum, with weights so adjusted at the bottom and above the light that the oscillation of the pendulum differs from the roll of the vessel, and the stability and consequent visibility of the light is thereby increased.

Altogether the papers furnish interesting indications of some of the advances being achieved in the execution of waterways, maritime works, and the lighting of shoals and channels; and the prospect of important extensions of waterways is manifested by the Dortmund and Ems Canal, forming merely the first instalment of a waterway intended to connect most of the rivers of Prussia, and the proposal of a Russian engineer for constructing a deep waterway to connect the White Sea and the Baltic, capable of being traversed by large seagoing vessels.

ITALIAN GEOLOGY.[1]

AN elaborate memoir, containing results of a study of the rocks and geology of the basin of the Sesia with the exception of its lower portion, the Strona valley and the western portion of the Orta lake, has lately been issued. The authors remark that, having made traverses of this region in several directions, noting many stratigraphical details, they were obliged to recognise the impossibility of the task of determining the "absolute chronological value" of the different formations. Neither does their microscopic examination of the rocks help them more to unravel the stratigraphical problems. This is a result which is not infrequent where petrographical methods are treated as paramount. Petrography, as I have frequently laid stress upon, is but *an aid* to geology, a valuable one, I admit, but inferior to good and accurate field-work, lithology, and a wide general knowledge of the surrounding region, and especially of the habits in other regions of the same class of rocks.

The authors have, as they but too justly point out, to contend with the absence of any known fossiliferous horizon, or in fact any stratigraphical standard formation as a datum to work from. In addition a large mass of volcanics traverse the Valsesia between the two principal crystalline formations and produce uncertainty in the limits of each, further disturbing the already complex stratigraphical arrangement and masking the relations of one to the other. At the commencement of the paper is a bibliographical list of fifty-three memoirs dealing with the locality in question.

It was found convenient for the petrographical studies to divide the rocks of the higher basin of the Sesia into five groups:—

(1) Gneiss of Strona (with an appendix on the granites).
(2) Massive augitic and hornblendic rocks.
(3) Gneiss of Sesia (including the schists of Rimella and Fobello).
(4) Greenstones (pietre verde) properly so called.
(5) Gneiss of Monte Rosa.

The authors deserve much credit for not venturing beyond the old nomenclature of Gerlach and Parona, the earlier students of this region.

Under the first group are included mica-schists with silli-

[1] "Ricerche Petrografiche e Geologiche sulla Valsesia," by E. Artini and G. Melzi (*Mem. del R. Istituto Lombardo di Sc. e Lett.*, vol. xvii. pp. 219–392; pl. xxii.).